

IN THE CLAIMS:

Please amend Claims 1, 20, 31, 33, 65, 78, 97, 114 and 116 as follows.

1. (Currently Amended) A method of creating an image using a computer comprised of a processor and a memory, the image being formed by rendering a plurality of graphical objects to be composited according to an expression tree representing a compositing expression for the image, the expression tree including a plurality of nodes each representing an object of the image or an operation for combining sub-expressions of the compositing expression, said method comprising the steps of:

determining an opacity region representation for each leaf node of the nodes of the expression tree, the opacity region representation comprising one or more of three predetermined values, each predetermined value distinctly identifying whether a corresponding region of an object represented by the leaf node is an opaque region, a transparent region or a partially transparent region such that the opacity region representation simultaneously represents each opaque region, transparent region and partially transparent region of the object represented by the leaf node, wherein a union of each opacity region representation for the expression tree includes at least one of each of the three predetermined values;

determining an obscurance region representation for at least one leaf node based on an analysis of the opacity region representation associated with the at least one leaf node, such that, for the image, the at least one leaf node simultaneously comprises both the opacity region representation and the obscurance region representation, with the obscurance

region representation being separate from the opacity region representation of the at least one leaf node, the obscurance region representation being assigned one or more of a plurality of further predetermined values, each further predetermined value of the obscurance region representation distinctly identifying whether a corresponding region of the object represented by the at least one leaf node is hidden by another object or is visible in the image;

partitioning the object into a plurality of regions;

overlaying the obscurance region representation on the partitioned object such that the partitioned object is substantially encompassed within the obscurance region representation;

traversing the overlaid obscurance region representation to identify any of the plurality of regions of the partitioned object which include at least a portion of the visible region;

rendering the identified regions of the object that are visible in the image, based on the traversal of the overlaid obscurance region representation to create the image, wherein the opacity region representation and the obscurance region representation are associated with the same leaf node; and

outputting the formed image to an image output device.

2. (Previously Presented) The method according to claim 1, said method including the further step of traversing the expression tree to detect the node including the obscurance region representation.

3. (Previously Presented) The method according to claim 1, wherein the obscurance region representation is traversed for each of the plurality of regions of the partitioned object.

4. (Previously Presented) The method according to claim 1, said method including the further step of producing a map for the plurality of regions, wherein the map at least indicates any region which includes at least a portion of the visible region.

5. (Previously Presented) The method according to claim 4, wherein the map includes a flag for each of the regions which includes at least a portion of the visible region.

6. (Previously Presented) The method according to claim 4, wherein the map is produced using run-length encoding.

7. (Previously Presented) The method according to claim 4, wherein the map is traversed in a predetermined order to determine the identified regions.

8. (Previously Presented) The method according to claim 1, said method including the further step of converting the expression tree into a right leaning expression tree.

9. (Previously Presented) The method according to claim 1, wherein the expression tree is a graphic object tree.

10. (Previously Presented) The method according to claim 1, wherein the obscurance region representation is a quadtree.

Claims 11-19. (Cancelled).

20. (Currently Amended) A computer apparatus having a processor and a memory for creating an image, the image being formed by rendering a plurality of graphical objects to be composited according to an expression tree representing a compositing expression for the image, the expression tree including a plurality of nodes each representing an object of the image or an operation for combining sub-expressions of the compositing expression, said apparatus further comprising:

opacity region representation determining means for determining an opacity region representation for each leaf node of the nodes of the expression tree, the opacity region representation comprising one or more of three predetermined values, each predetermined value distinctly identifying whether a corresponding region of an object represented by the leaf node is an opaque region, a transparent region or a partially transparent region such that the opacity region representation simultaneously represents each opaque region, transparent region and partially transparent region of the object represented by the leaf node, wherein a union of

each opacity region representation for the expression tree includes at least one of each of the three predetermined values;

obscurance region representation determining means for determining an obscurance region representation for at least one leaf node of the expression tree based on an analysis of the opacity region representation associated with the at least one leaf node, such that, for the image, the at least one leaf node simultaneously comprises both the opacity region representation and the obscurance region representation, with the obscurance region representation being separate from the opacity region representation of the at least one leaf node, the obscurance region representation being assigned one or more of a plurality of further predetermined values, each further predetermined value of the obscurance region representation distinctly identifying whether a corresponding region of the object represented by the at least one leaf node is hidden by another object or is visible in the image;

partitioning means for partitioning the object into a plurality of regions;

overlaying means for overlaying the obscurance region representation on the partitioned object such that the partitioned object is substantially encompassed within the obscurance region representation;

traversing means for traversing the overlaid obscurance region representation to identify any of the plurality of regions of the partitioned object which include at least a portion of the visible region;

rendering means for rendering the identified regions of the object that are visible in the image, based on the traversal of the overlaid obscurance region representation

to create the image, wherein the opacity region representation and the obscurance region representation are associated with the same leaf node; and

an image output device for outputting the formed image.

21. (Previously Presented) The apparatus according to claim 20, wherein said traversing means further traverses the expression tree to detect the node including the obscurance region representation.

22. (Previously Presented) The apparatus according to claim 20, wherein the obscurance region representation is traversed for each of the plurality of regions of the partitioned object.

23. (Previously Presented) The apparatus according to claim 20, further comprising map producing means for producing a map for the plurality of regions, wherein the map at least indicates any region which includes at least a portion of the visible region.

24. (Previously Presented) The apparatus according to claim 20, wherein the expression tree is a graphic object tree.

25. (Previously Presented) The apparatus according to claim 20, wherein the obscurance region representation is a quadtree.

Claims 26-30. (Cancelled).

31. (Currently Amended) A computer-readable medium encoded with [[a]] computer-executable instructions causing a computer to perform a method of creating an image, the image being formed by rendering a plurality of graphical objects to be composited according to an expression tree representing a compositing expression for the image, the expression tree including a plurality of nodes each representing an object of the image or an operation for combining sub-expressions of the compositing expression, said method comprising the steps of:

determining an opacity region representation for each leaf node of the nodes of the expression tree, the opacity region representation comprising one or more of three predetermined values, each predetermined value distinctly identifying whether a corresponding region of an object represented by the leaf node is an opaque region, a transparent region or a partially transparent region such that the opacity region representation simultaneously represents each opaque region, transparent region and partially transparent region of the object represented by the leaf node, wherein a union of each opacity region representation for the expression tree includes at least one of each of the three predetermined values;

determining an obscurance region representation for at least one leaf node based on an analysis of the opacity region representation associated with the at least one leaf node, such that, for the image, the at least one leaf node simultaneously comprises both the opacity region representation and the obscurance region representation, with the obscurance region representation being separate from the opacity region representation of the at least one leaf

node, the obscurance region representation being assigned one or more of a plurality of further predetermined values, each further predetermined value of said obscurance region representation distinctly identifying whether a corresponding region of the object represented by the at least one leaf node is hidden by another object or is visible in the image;

partitioning the object into a plurality of regions;

overlaying the obscurance region representation on the partitioned object such that the partitioned object is substantially encompassed within the obscurance region representation;

traversing the overlayed obscurance region representation to identify any of the plurality of regions of the partitioned object which include at least a portion of the visible region; ~~and~~

rendering the identified regions of the object that are visible in the image, based on the traversal of the overlayed obscurance region representation to create the image, wherein the opacity region representation and the obscurance region representation are associated with the same leaf node; and

outputting the formed image to an image output device.

Claim 32. (Cancelled).

33. (Currently Amended) A method of creating an image using a computer comprised of a processor and a memory, the image being formed by rendering at least a plurality



of graphical objects to be composited according to an expression tree, the expression tree representing a compositing expression for the image and comprising a plurality of nodes, each node of the expression tree representing an object of the image or an operation for combining sub-expressions of the compositing expression, said method comprising the steps of:

determining an opacity region representation for each leaf node of the nodes of the expression tree, the opacity region representation comprising one or more of three predetermined values, each predetermined value distinctly identifying whether a corresponding region of an object represented by the leaf node is an opaque region, a transparent region or a partially transparent region such that the opacity region representation simultaneously represents each opaque region, transparent region and partially transparent region of the object represented by the leaf node; and

determining an obscurance region representation for at least one leaf node of the expression tree based on an analysis of the opacity region representation associated with the at least one leaf node, such that, for the image, the at least one node simultaneously comprises both the opacity region representation and the obscurance region representation, with the obscurance region representation being separate from the opacity region representation of the at least one leaf node, the obscurance region representation being assigned one or more of a plurality of further predetermined values, each further predetermined value of the obscurance region representation distinctly identifying whether a corresponding region of the object represented by the node is hidden by another object or is visible in the image;

rendering the regions of the object that are visible in the image, based on a traversal of the obscurance region representation, to create the image, wherein the opacity region representation and the obscurance region representation are associated with the same leaf node; and

outputting the formed image to an image output device.

34. (Previously Presented) The method according to claim 33, wherein the opacity region representation is a first hierarchical structure.

35. (Previously Presented) The method according to claim 33, wherein the obscurance region representation is a second hierarchical structure.

36. (Previously Presented) The method according to claim 33, said method comprising the further step of identifying nodes representing a complex graphical object.

37. (Previously Presented) The method according to claim 36, said method comprising the further step of determining an opacity region representation for each node identified.

Claims 38 and 39. (Cancelled).

40. (Previously Presented) The method according to claim 33, wherein an opacity region representation of a child node is at least propagated to a parent node associated with the child node.

Claim 41. (Cancelled).

42. (Previously Presented) The method according to claim 33, wherein an obscurance region representation of a parent node is at least propagated to a child node associated with the parent node.

43. (Previously Presented) The method according to claim 34, wherein the first hierarchical structure is dependent on an operation associated with a node for which the first hierarchical structure is constructed.

44. (Previously Presented) The method according to claim 35, wherein the second hierarchical structure for a node is constructed by combining any first hierarchical structures associated with the node.

45. (Previously Presented) The method according to claim 34, wherein each leaf node of the first hierarchical structure is assigned one of the predetermined values depending on an opacity of a region associated with the leaf node.

46. (Previously Presented) The method according to claim 33, said method including the further step of converting the expression tree into a right leaning tree.

47. (Previously Presented) The method according to claim 34, wherein each node of the first hierarchical structure comprises a pointer indicating children nodes associated with the node.

48. (Previously Presented) The method according to claim 35, wherein the second hierarchical structure is a quadtree.

49. (Previously Presented) The method according to claim 33, wherein the opacity region representation is a bounding box.

50. (Previously Presented) The method according to claim 33, wherein the obscurance region representation is a bounding box.

Claims 51-64. (Cancelled).

65. (Currently Amended) A computer apparatus having a processor and a memory for creating an image, the image being formed by rendering at least a plurality of graphical objects to be composited according to an expression tree, the expression tree

representing a compositing expression for the image and comprising a plurality of nodes, each node of the expression tree representing an object of the image or an operation for combining sub-expressions of the compositing expression, said apparatus further comprising:

means for determining an opacity region representation for each leaf node of the nodes of the expression tree, the opacity region representation comprising one or more of three predetermined values, each predetermined value distinctly identifying whether a corresponding region of an object represented by the leaf node is an opaque region, a transparent region or a partially transparent region such that the opacity region representation simultaneously represents each opaque region, transparent region and partially transparent region of the object represented by the leaf node; and

means for determining an obscurance region representation for at least one leaf node of the expression tree based on an analysis of the opacity region representation associated with the at least one leaf node, such that, for the image, the at least one node simultaneously comprises both the opacity region representation and the obscurance region representation, with the obscurance region representation being separate from the opacity region representation of the at least one leaf node, the obscurance region representation being assigned one or more of a plurality of further predetermined values, each further predetermined value of the obscurance region representation distinctly identifying whether a corresponding region of the object represented by the node is hidden by another object or is visible in the image;

means for rendering the regions of the object that are visible in the image, based on a traversal of the obscurance region representation, to create the image, wherein

the opacity region representation and the obscurance region representation are associated with the same leaf node; and

an image output device for outputting the formed image.

66. (Previously Presented) The apparatus according to claim 65, wherein the opacity region representation is a first hierarchical structure.

67. (Previously Presented) The apparatus according to claim 65, wherein the obscurance region representation is a second hierarchical structure.

68. (Previously Presented) The apparatus according to claim 65, further comprising means for identifying nodes representing a complex graphical object.

69. (Previously Presented) The apparatus according to claim 68, further comprising means for determining an opacity region representation for each node identified.

70. (Previously Presented) The apparatus according to claim 67, wherein the second hierarchical structure is a quadtree.

71. (Previously Presented) The apparatus according to claim 65, wherein the opacity region representation is a bounding box.

72. (Previously Presented) The apparatus according to claim 65, wherein the obscurance region representation is a bounding box.

Claims 73-77. (Cancelled).

78. (Currently Amended) A computer-readable medium encoded with computer-executable instructions causing a computer to perform a method of creating an image, the image being formed by rendering at least a plurality of graphical objects to be composited according to an expression tree, the expression tree representing a compositing expression for the image and comprising a plurality of nodes, each node of the expression tree representing an object of the image or an operation for combining sub-expressions of the compositing expression, said method comprising the steps of:

determining an opacity region representation for each leaf node of the nodes of the expression tree, the opacity region representation comprising one or more of three predetermined values, each predetermined value distinctly identifying whether a corresponding region of an object represented by the leaf node is an opaque region, a transparent region or a partially transparent region such that the opacity region representation simultaneously represents each opaque region, transparent region and partially transparent region of the object represented by the leaf node;

determining an obscurance region representation for at least one leaf node of the expression tree based on an analysis of the opacity region representation associated

with the at least one leaf node, such that, for the image, the at least one leaf node simultaneously comprises both the opacity region representation and the obscurance region representation, with the obscurance region representation being separate from the opacity region representation of the at least one leaf node, the obscurance region representation being assigned one or more of a plurality of further predetermined values, each further predetermined value of the obscurance region representation distinctly identifying whether a corresponding region of the object represented by the node is hidden by another object or is visible in the image; ~~and~~

rendering the regions of the object that are visible in the image, based on a traversal of the obscurance region representation, to create the image, wherein the opacity region representation and the obscurance region representation are associated with the same leaf node; and

outputting the formed image to an image output device.

Claims 79-96. (Cancelled).

97. (Currently Amended) A method of creating an image using a computer comprised of a processor and a memory, the image being formed by rendering at least a plurality of graphical objects to be composited according to an expression tree, the expression tree representing a compositing expression for the image and comprising a plurality of nodes, each node of the expression tree representing an object of the image or an operation for combining sub-expressions of the compositing expression, said method comprising the steps of:



performing a first traversal of the expression tree to determine an opacity region representation for each leaf node of the expression tree, the opacity region representation comprising one or more of three predetermined values, each predetermined value distinctly identifying whether a corresponding region of an object represented by the leaf node is an opaque region, a transparent region or a partially transparent region such that the opacity region representation simultaneously represents each opaque region, transparent region and partially transparent region of the object represented by the leaf node;

identifying leaf nodes of the expression tree, for which compositing information is required, depending on the opacity region representation associated with each leaf node;

performing a second traversal of the expression tree to determine compositing region representations for each identified leaf node of the expression tree, such that, for the image, the leaf node simultaneously comprises both the opacity region representation and the compositing region representation, wherein the compositing region representation for each leaf node is separate from the opacity region representation for each leaf node and is determined using the opacity region representation determined for each leaf node, and wherein the compositing region representation indicates at least regions of an object represented by the leaf node that are hidden by another object, load regions and visible regions;

rendering the regions of the object that are visible in the image, based on a traversal of the compositing region representation, to create the image, wherein the opacity

region representation and the compositing region representation are associated with the same leaf node; and

outputting the formed image to an image output device.

98. (Previously Presented) The method according to claim 97, wherein the compositing information is represented by a first hierarchical structure.

99. (Previously Presented) The method according to claim 98, wherein the opacity region representation comprises a second hierarchical structure representing an opacity of a region associated with a node.

100. (Previously Presented) The method according to claim 97, wherein the opacity region representation is a bounding box representing an opacity of a region associated with a node.

101. (Previously Presented) The method according to claim 98, wherein the first hierarchical structure is dependent on the opacity region representation.

102. (Previously Presented) The method according to claim 97, wherein the first traversal is a bottom-up traversal.

103. (Previously Presented) The method according to claim 99, wherein opacity region representation of a child node is at least propagated to a parent node associated with the child node.

104. (Previously Presented) The method according to claim 103, wherein an opacity region representation of the parent node is determined by merging at least two second hierarchical structures.

105. (Previously Presented) The method according to claim 103, wherein opacity region representation of the parent node is determined by merging at least one second hierarchical structure and a bounding box.

106. (Previously Presented) The method according to claim 97, wherein the second traversal is a top-down traversal.

107. (Previously Presented) The method according to claim 106, wherein a first hierarchical structure of a parent node is at least propagated to a child node associated with the parent node.

Claims 108-113. (Cancelled).

114. (Currently Amended) A computer apparatus having a processor and a memory for creating an image, the image being formed by rendering at least a plurality of graphical objects to be composited according to an expression tree, the expression tree representing a compositing expression for the image and comprising a plurality of nodes, each node of the expression tree representing an object of the image or an operation for combining sub-expressions of the compositing expression, said apparatus further comprising:

means for performing a first traversal of the expression tree to determine an opacity region representation for each leaf node of the nodes of the expression tree, the opacity region representation comprising one or more of three predetermined values, each predetermined value distinctly identifying whether a corresponding region of an object represented by the leaf node is an opaque region, a transparent region or a partially transparent region such that the opacity region representation simultaneously represents each opaque region, transparent region and partially transparent region of the object represented by the leaf node;

means for identifying leaf nodes of the nodes of the expression tree, for which compositing information is required, depending on the opacity region representation associated with each node;

means for performing a second traversal of the expression tree to determine compositing region representations for each identified leaf node, such that, for the image, the leaf node simultaneously comprises both the opacity region representation and the composite region representation, wherein the compositing region representation for each leaf node is separate from the opacity region representation for the leaf node and is determined using

the opacity region representation determined for each leaf node, and wherein the compositing region representation indicates at least regions of an object represented by the node that are hidden by another object, load regions and visible regions;

means for rendering the regions of the object that are visible in the image, based on a traversal of the compositing region representation, to create the image, wherein the opacity region representation and the compositing region representation are associated with the same leaf node; and

an image output device for outputting the formed image.

Claim 115. (Cancelled).

116. (Currently Amended) A computer readable medium encoded with computer-executable ~~instruction~~ instructions causing a computer to perform a method of creating an image, the image being formed by rendering at least a plurality of graphical objects to be composited according to an expression tree, the expression tree representing a compositing expression for the image and comprising a plurality of nodes, each node of the expression tree representing an object of the image or an operation for combining sub-expressions of the compositing expression, said method comprising the steps of:

performing a first traversal of the expression tree to determine an opacity region representation for each leaf node of the nodes of the expression tree, the opacity region representation comprising one or more of three predetermined values, each predetermined

value distinctly identifying whether a corresponding region of an object represented by the leaf node is an opaque region, a transparent region or a partially transparent region such that the opacity region representation simultaneously represents each opaque region, transparent region and partially transparent region of the object represented by the leaf node;

identifying leaf nodes of the expression tree for which compositing information is required, depending on the opacity region representation associated with each leaf node;

performing a second traversal of the expression tree to determine compositing region representations for each identified leaf node, such that, for the image, the leaf node simultaneously comprises both the opacity region representation and the compositing region representation, wherein the compositing region representation for each leaf node is separate from the opacity region representation for each leaf node and is determined using the opacity region representation determined for each leaf node, and wherein the compositing region representation indicates at least regions of an object represented by the node that are hidden by another object, load regions and visible regions; ~~and~~

rendering the regions of the object that are visible in the image, based on a traversal of the compositing region representation, to create the image, wherein the opacity region representation and the compositing region representation are associated with the same leaf node; and

outputting the formed image to an image output device.